

The Ames Vertical Gun Range

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Overview

- Laboratory-scale investigations of high-speed impact processes
- Projectile speeds up to 7 km s^{-1}
- Variable angle between launch vector and gravity vector
- Large target chamber that can be evacuated and/or back-filled with various gases



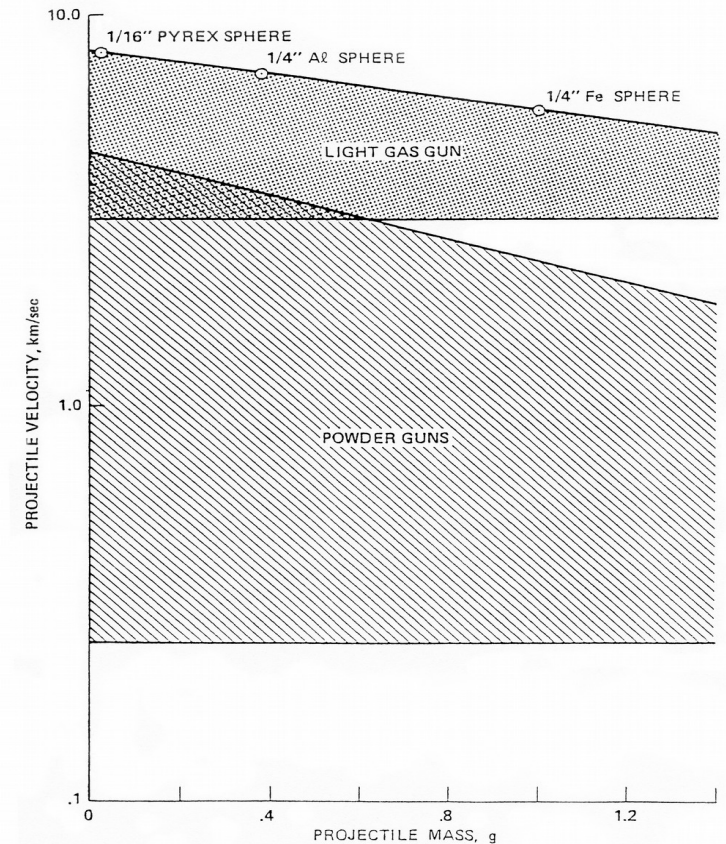
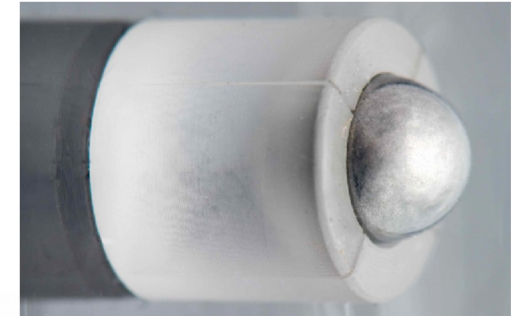
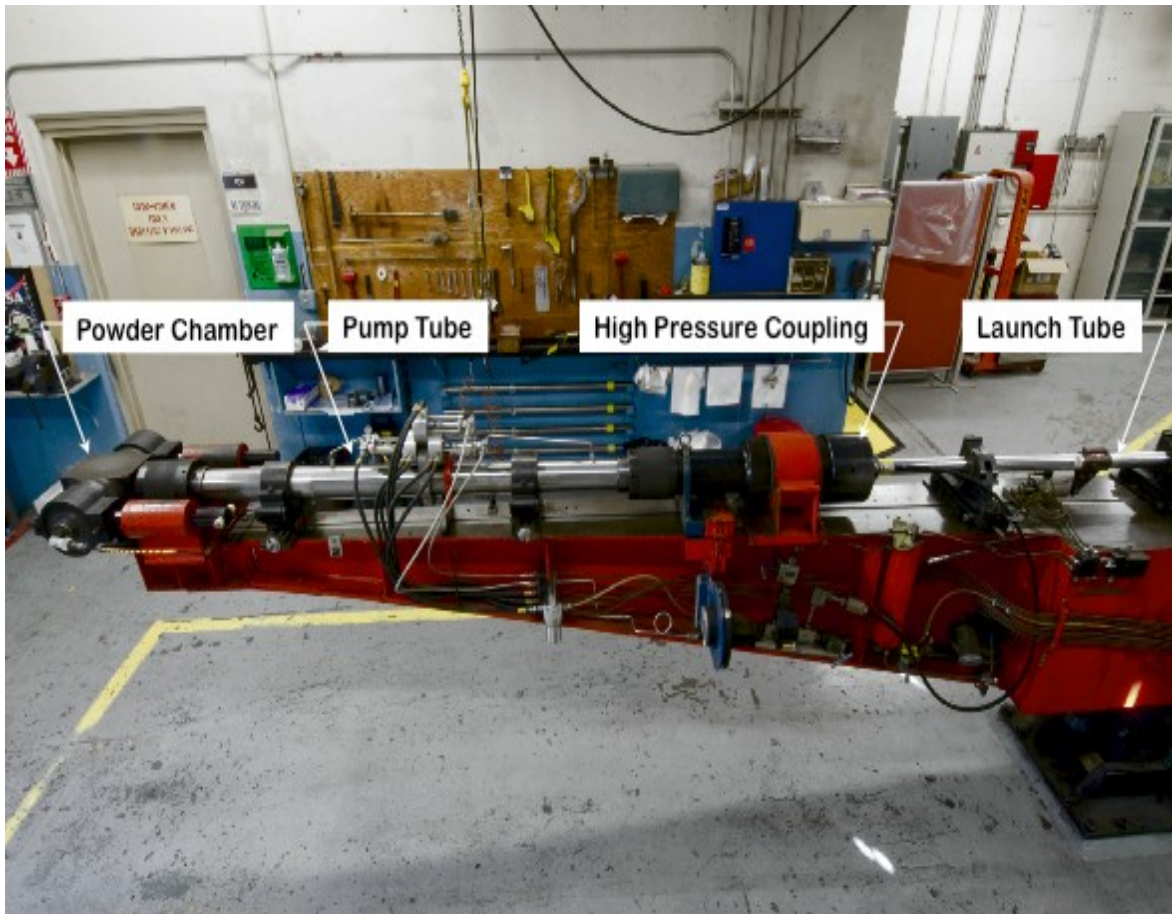
Purpose



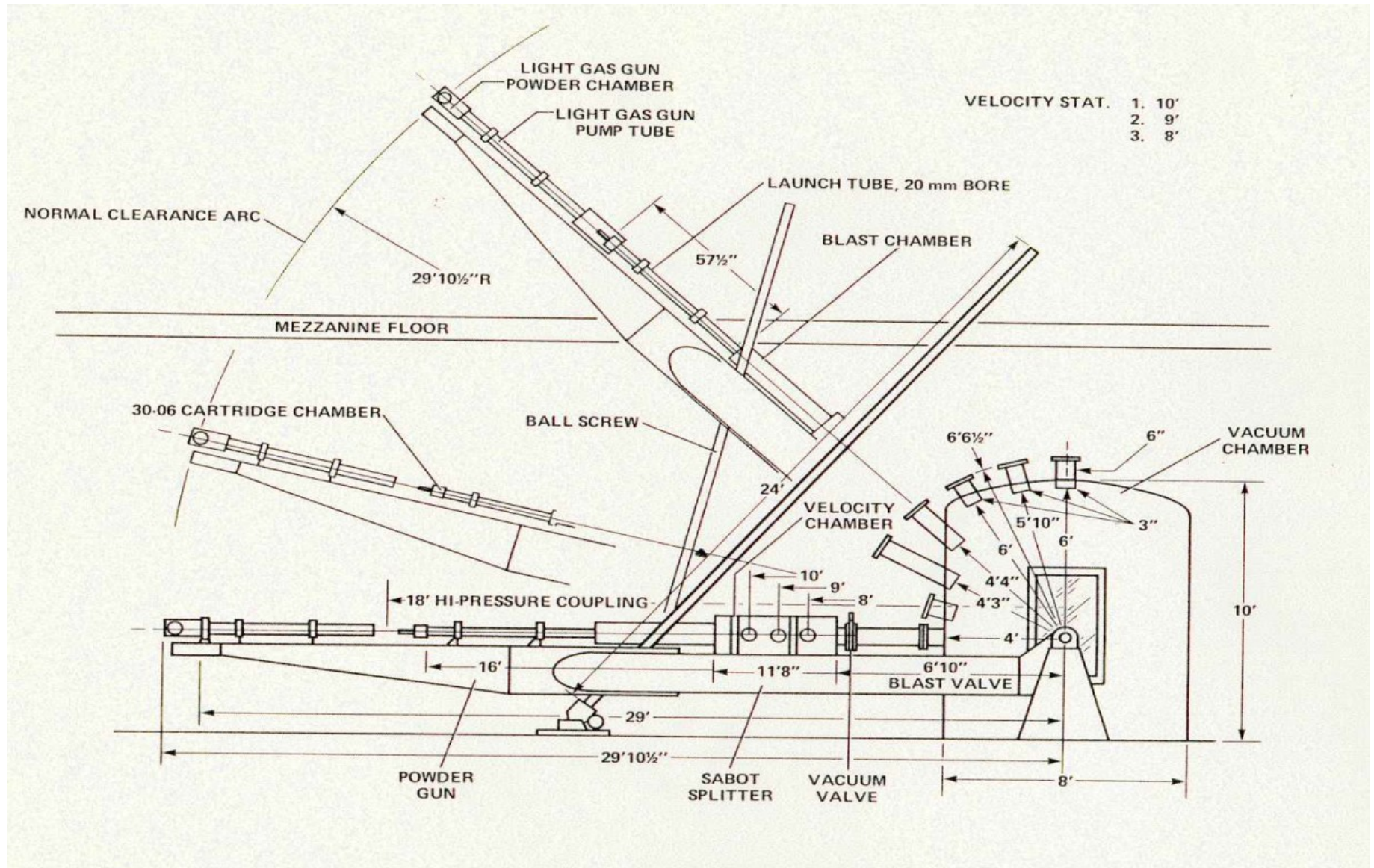
- Laboratory-scale examination of impact processes, e.g.
 - Crater formation
 - Impactor fate
 - Debris dispersion and characterization
 - Debris strikes on spacecraft
- Mission design and development
 - Stardust, Deep Impact, LCROSS, and others
- Created in 1966 for the Apollo program
- Established as a National Facility in 1979

Model-launching guns

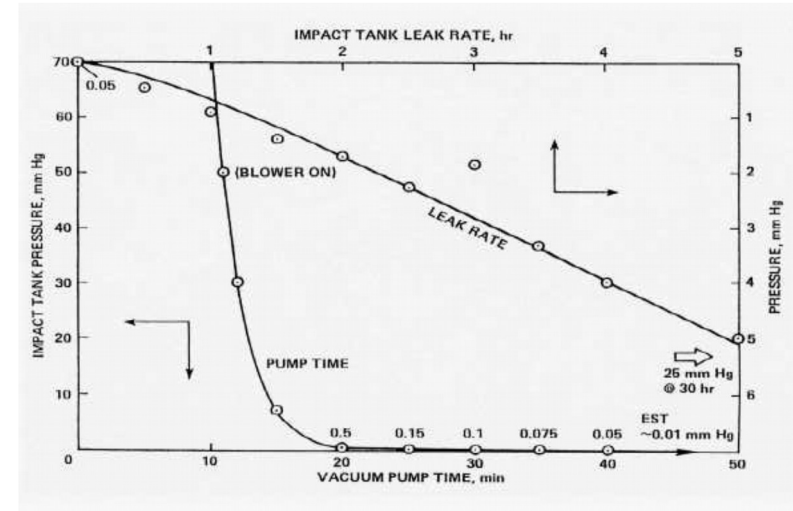
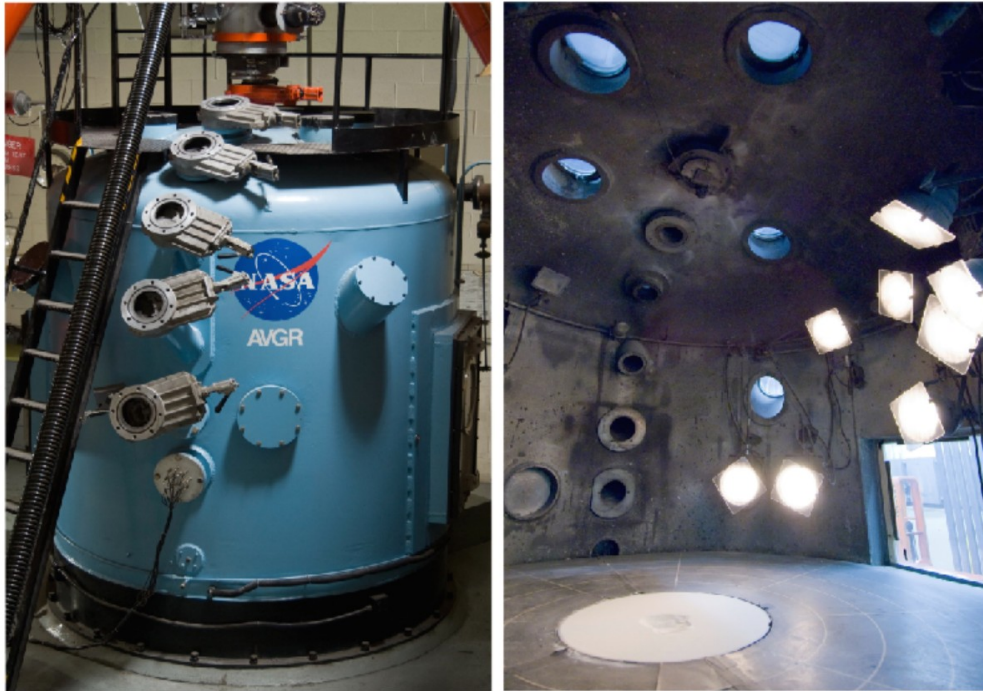
30 caliber light-gas and powder



Variable launch angle



Impact chamber



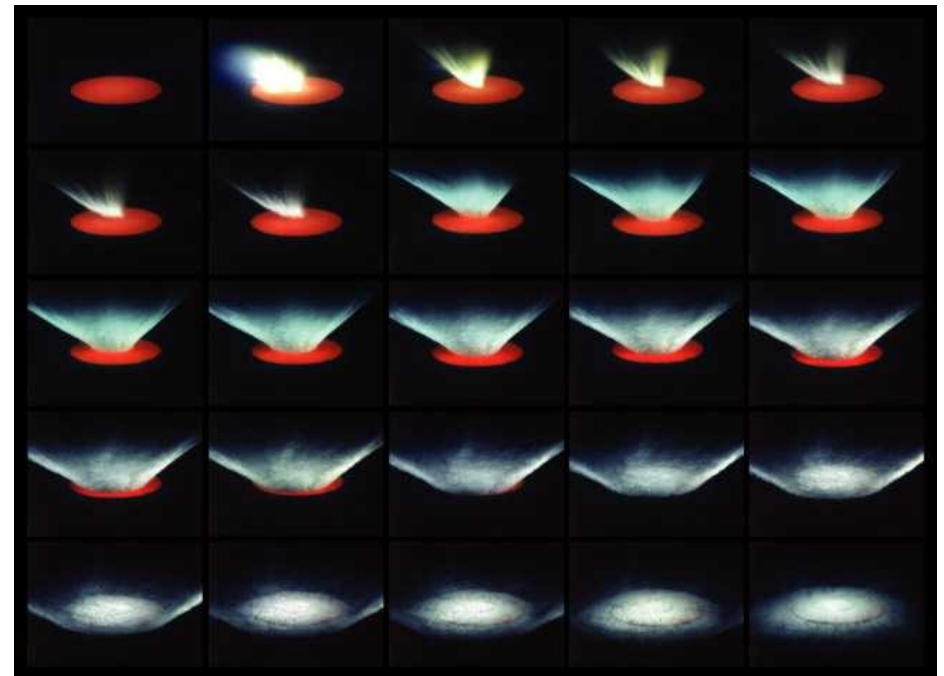
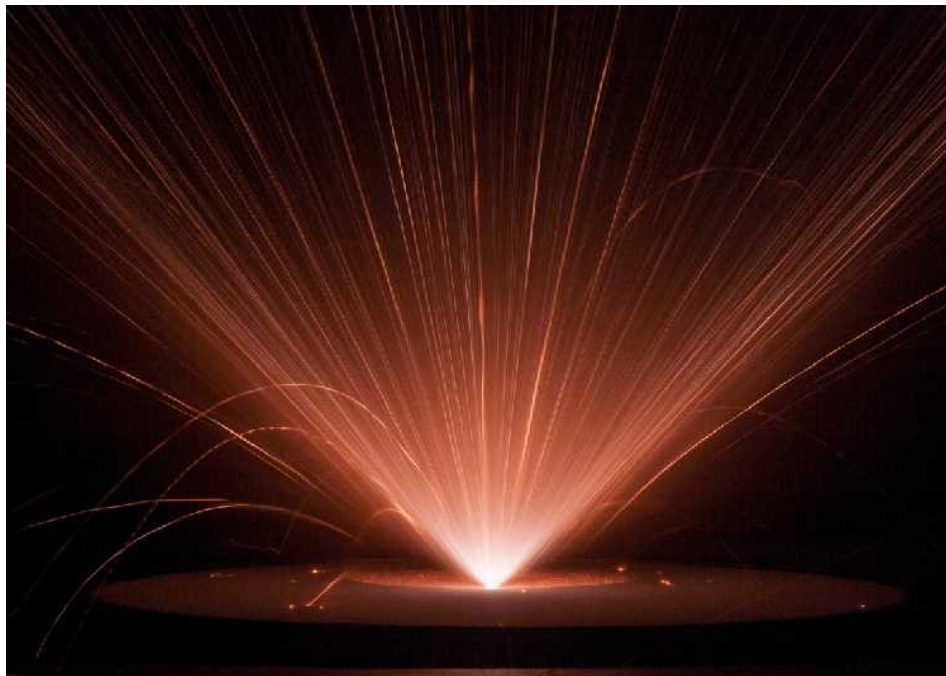
- Large size (2.4 m dia. and height) minimizes target disturbances & contamination due to gun gases
- Can accommodate variable gases/atmospheres
- Minimum chamber pressure ~ 50 Pa



Instrumentation



High-speed video systems include pairs of Vision Research Phantom V-10, V-12 and V-2512 plus Shimadzu HPV-1 cameras



Contributions to planetary science

Fundamental impact physics

Crater scaling (controlling variables)

Ejecta mass-velocity distribution

Fragmentation

Shock evolution

Evolving crater flow field

Benchmarks for computation models

Effects of porosity

Crater scaling

Ejecta evolution

Chemical evolution

Volatile delivery to and retention on the Moon and Mercury

Insight into geological processes responsible for observations

Impact delivery of organics and water

Link between IDPs, meteorites, and asteroids

Survival of organics

Formation of crater-ejecta morphologies on Mars and Venus

Stimulus for new computational models and approaches

Role of shear

Global response to impact-generated shock

Impactor survival

Effect of low-impedance veneers

Seismic effects

Also: Planetary defense, astrobiology, and public outreach



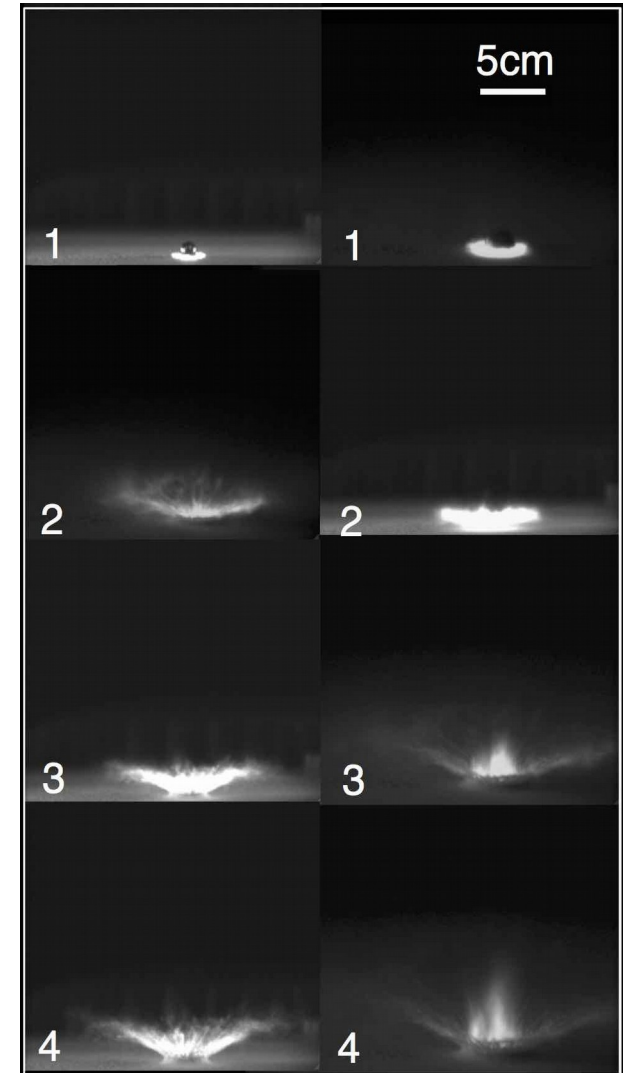
Mission design

- **AIDA** (Asteroid Impact & Deflection Assessment)
- **LCROSS**
- **Lunar Reconnaissance Orbiter**
- **Deep Impact, Stardust-NExT**
- **Mars Exploration Rovers, Mars Odyssey, Cassini**
- **SCIM**
- **Aladdin (Phase A)**
- **Stardust**

Mission analysis

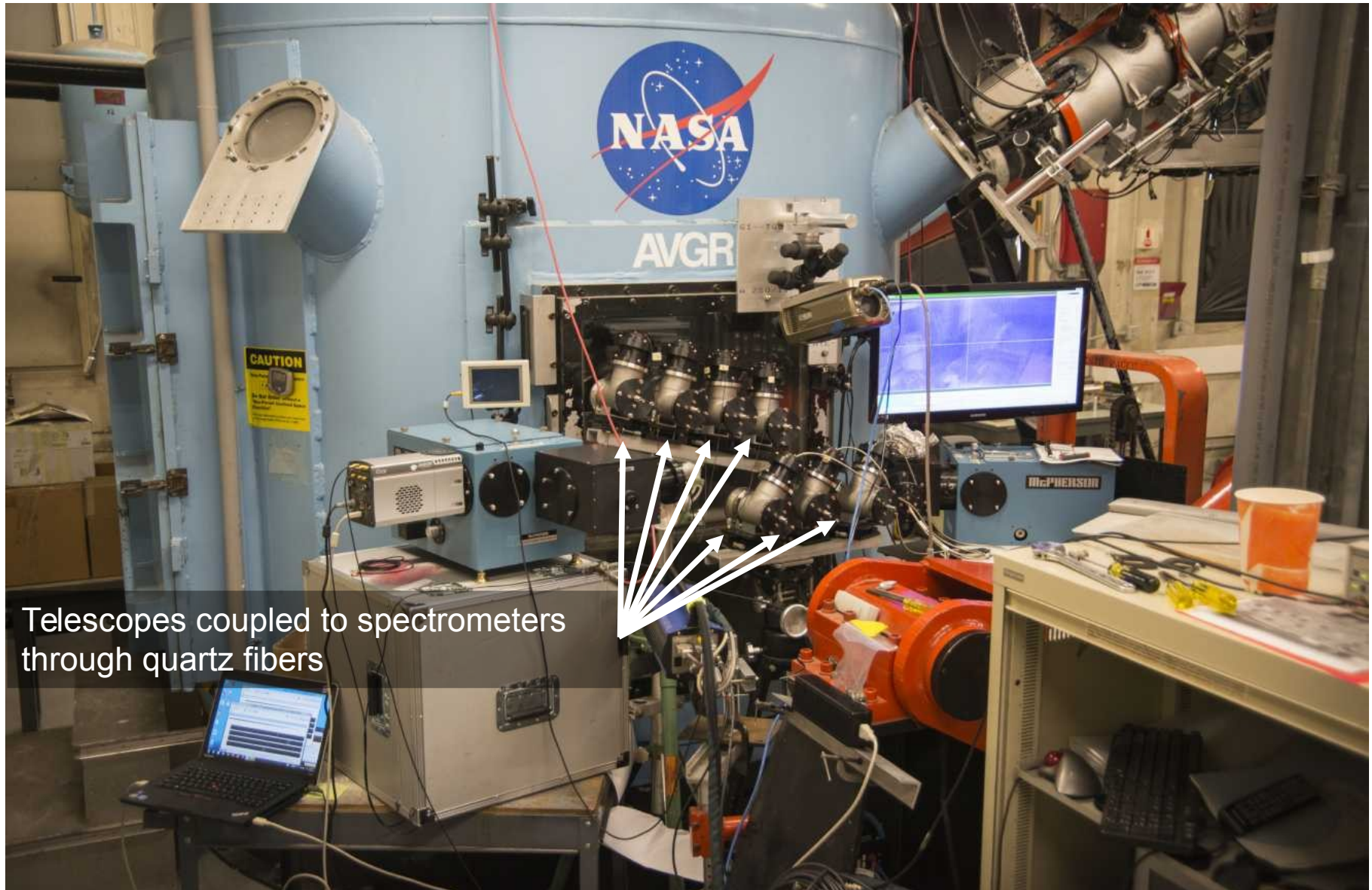


- Dawn
- MRO, MGS, Mars Odyssey, Viking
- MESSENGER
- LCROSS
- Lunar Reconnaissance Orbiter
- Deep Impact, Stardust-NExT
- NEAR
- Stardust
- Clementine
- Magellan
- Apollo
- Surveyor



Modified from Schultz et al. (2010)

Example investigation: Evolution of impact-generated vapor

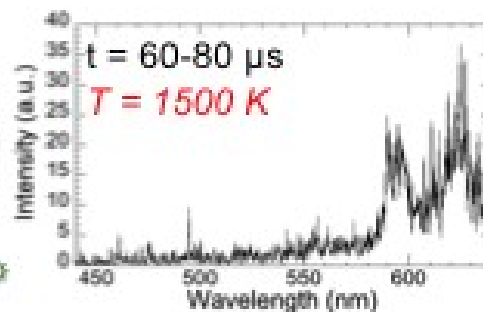
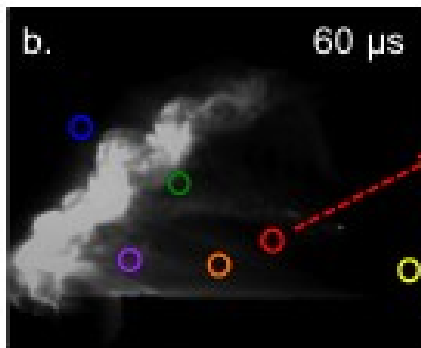
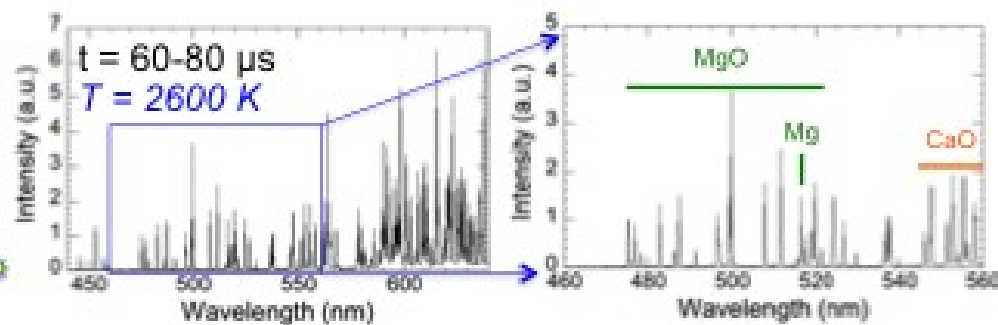
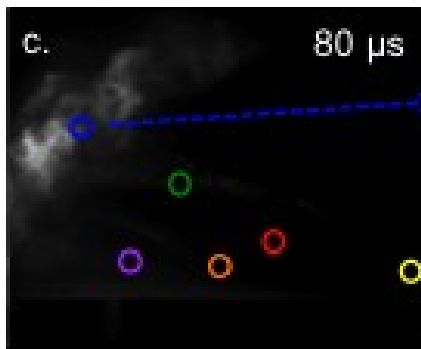
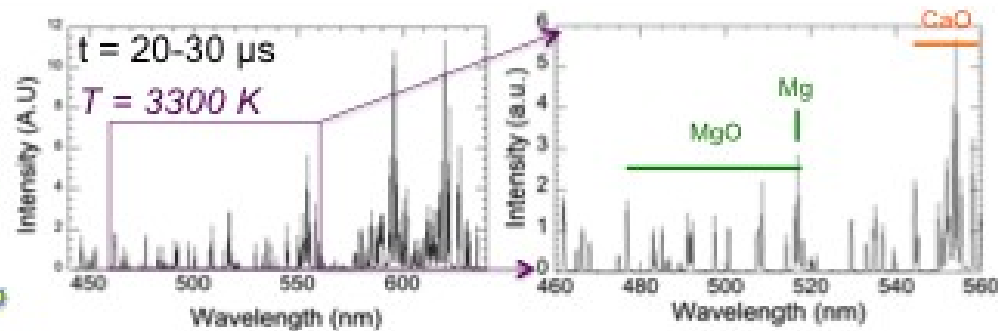
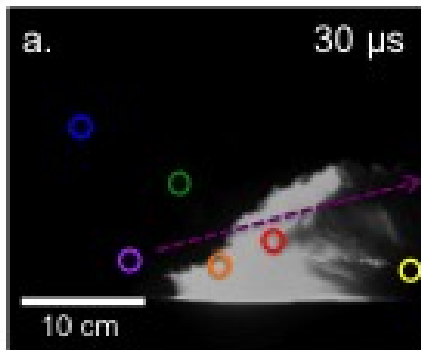


Telescopes coupled to spectrometers through quartz fibers

Example investigation: Evolution of impact-generated vapor



Bruck Syal & Schultz 2014



Access



- Available through ROSES Planetary Science Research Program (PSRP) elements
 - Instructions are included in the PSRP section
- Also available for mission development and planning (at cost)
- 1–2 day exploratory studies to enable new proposals or programs are additionally possible

Full description of the facility is available at the Ames Thermophysics Branch website:

<http://www.nasa.gov/centers/ames/thermophysics-facilities/>

Summary



- The AVGR contributes to our understanding of fundamental impact physics and geological processes throughout the Solar System
- Unique capabilities include its variable launch angle and large impact chamber with variable atmospheric composition
- Access is available through ROSES Planetary Science elements